

# MACHINE DESIGN

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### Volume 45—January to December

Including 26 regular issues of MACHINE DESIGN plus five special issues—*The Plastics/Elastomers Reference Issue, Electric Controls Reference Issue, Mechanical Drives Reference Issue, Seals Reference Issue, Fastening & Joining Reference Issue*. Only articles and editorial items one-half page or larger are indexed.

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The Rotary Actuator .....	Polentz	12/13	159	(5.0)

### 26. Seals

Specifying Seals in Vanes .....	Polentz	4/5	114	(5.0)
Air-Supported Shaft Seal Bottles Up High Pressure .....	Scan	8/9	46	(0.5)
Face Seals: General Types .....	Trimble	8/9/13	2	(4.7)
Face Seals: Metal-Bellows Types .....	Trimble	8/9/13	6	(1.3)
Dynamic Shaft Seals: Radial Lip Seals...	Wilkinson	8/9/13	20	(5.0)
Improved Seals for Poppet Valves .....	Dann	10/18	170	(1.0)
Gasket Keeps Out Water .....	Scan	2/8	146	(1.0)
Nonmetallic Gaskets: Gasket Materials and Forms .....	Smoley	8/9/13	104	(3.8)
Metallic Gaskets: General Types .....	Painter & Rhine	8/9/13	119	(3.7)
Metallic Gaskets: O-Ring Types .....	Gastineau	8/9/13	122	(1.3)
Dynamic Shaft Seals: Exclusion Devices	Hooper	8/9/13	25	(2.0)
Dynamic Shaft Seals: Circumferential Seals .....	Taschenberg & Moskowicz	8/9/13	27	(2.2)
Dynamic Shaft Seals: Radial Lip Seals...	Ileck	8/9/13	29	(1.6)
Split-Ring Seals .....	Shepler	8/9/13	58	(2.0)
Two-Piece Seat Stops Wear .....	Scan	2/8	148	(0.7)
Compression Packings .....	McKillop	8/9/13	64	(3.0)
Molded Packings: Lip Types .....	Boyce	8/9/13	70	(2.5)
Molded Packings: Squeeze Types .....	Gillette	8/9/13	72	(2.2)
Molded Packings: Felt Radial Types ..	Chapter	8/9/13	74	(1.2)
Diaphragm Seals .....	Marchetti & Diegnan	8/9/13	96	(2.0)

### 27. Valves

Ball Valves—A New Look at an Old Friend .....	Sanctuary	3/22	161	(5.0)
Specifying Seals in Valves .....	Polentz	4/5	114	(5.0)
Remote Modulation of Hydraulic Valves	Article	5/3	110	(2.0)
Removable Bridgeblock Eliminates Valve Bonnet .....	Scan	8/9	48	(0.5)
Eliminating Deadband from Hydraulic Valves .....	Kumar	9/20	167	(1.6)
Pneumatic Springs Actuate Fluid Valves ..	Scan	4/19	136	(0.5)
On-Off Sprinkler Safeguards Valuables...	N/T	8/23	8	(0.5)
The Ins and Outs of Butterfly Valves...	Bertrem	11/1	92	(5.0)
High-Volume Valve Relieves Pressure ..	Scan	8/23	43	(0.5)
Wrist Device Computes Decompression Stops .....	N/T	11/29	26	(0.5)
Quick Reflexes For Long-Range Hydraulics .....	Rao	5/31	95	(1.7)
Commuter Boats To Ski Into New York	N/T	7/26	8	(0.6)
A Sound Idea for Atomizing Liquids ..	Scan	11/15	44	(0.6)

### 28. Instruments & Controls

Controlling a Sequenced Operation .....	Boulden & Engstrom	2/22	101	(5.0)
Servo-Matched Pump Measures Flow Rate	Scan	10/4	42	(1.0)
Flying Wedge Meters Resins .....	Scan	10/18	50	(1.0)
Threshold Logic .....	Martin	1/25	102	(4.0)
Fluidic Feedback Interfaces Seed Meter and Monitor .....	Scan	2/8	147	(0.7)
Fluidics Take Touch Out of Film Measuring .....	Scan	4/5	131	(0.5)
Fluidic Readout Inks Permanent Record	Scan	8/23	46	(0.6)
Jet Deflector Simplifies Servo .....	Scan	12/13	43	(0.5)

### 29. Systems & Assemblies

Silencing the Noisy Hydraulic System ..	Miller	6/14	138	(6.0)
Circulatory Turbine Doubles Transmission Torque .....	Scan	7/26	38	(1.0)
Grinder Sucks Up Grit .....	Scan	12/27	36	(0.5)
Picking the Best Lubrication System ..	Callahan	4/19	125	(7.0)

## MECHANICAL

### 31. Power Sources

Going Metric: Mechanical Drives .....	Zimmerman & Lavoie	3/8	M-29	(8.0)
The Energy Crisis Can Be Solved .....	Article	2/22	28	(4.0)
Huge Rig Tests Aircraft Engines .....	N/T	2/8	18	(0.5)
Airports You Can Live With .....	Bryson	2/8	20	(5.0)
Pollution Controller Improves Performance	N/T	1/25	16	(0.5)
Rotary Outboard Engines Power Racing Boats .....	N/T	4/5	12	(1.0)
Engines .....	Chapter	MD 6/21	1	(3.0)
Ford Goes Metric With Mass-Produced Engine .....	N/T	7/12	26	(0.5)

Wankel-Like Engines .....	Article	8/9	20	(4.0)
Emissions Slashed by Fuel Reformer ..	Scan	8/9	42	(0.7)
Design for Offshore Powerboats .....	Bryson	8/23	20	(6.0)
Wankel Builders Narrow Field of Alternates Parts and Processes .....	N/T	10/4	8	(1.0)
Upside-Down V2 Engine Is Supersmooth and Quiet .....	N/T	10/18	10	(0.5)
Sarich Engine Progress Report .....	Article	11/1	32	(0.7)
Gas-Turbine Prototypes Keep Running...	Article	7/12	135	(0.8)
Commuter Boats To Ski Into New York	N/T	7/26	8	(0.6)
Turbines Change Exhaust Roar to Quiet Whistle .....	Article	11/29	25	(0.5)
Tiny Fold-Away Helicopter Flown .....	N/T	7/26	6	(1.0)

Progress Called Slow On Auto Emission Controls	N/T	4/5	34	(0.8)
Hydrogen Atoms Called Key To Pumping Liquid Coal	N/T	5/17	10	(0.8)
Method To Be Developed For Planning For Future Energy Needs	N/T	5/17	28	(0.5)
The Challenge of North-Sea Oil	Morse	6/14	18	(5.0)
Scientists Recommend Coal Baths	N/T	6/14	48	(0.5)
Federal Gas-Mileage Labeling for Autos Begins This Month	N/T	10/4	6	(1.0)
Aussie Steamer Makes U. S. Debut	N/T	1/11	32	(1.0)
Geothermal Power: Can It Help Solve the Energy Crisis?	Wehlage	5/3	30	(6.0)
Hot Rock May Be Tapped For Energy	N/T	7/26	26	(0.5)

## 32, 33, 34. Drives, Transmissions, Drive Components

Gears and Gear Drives: Base-Mounted Reducers	Lorvik	MD 6/21	42	(2.3)
Gears and Gear Drives: Shaft-Mounted Reducers	Chung	MD 6/21	45	(1.2)
Differential Offers Positive Traction	Scan	5/17	48	(0.6)
Gear and Gear Drives: Differentials	Merkert	MD 6/21	46	(1.6)
Geometric Progressions for Transmission Gears	Zanker	7/26	94	(1.5)
Dual Drives Share Load of Motorized Mill	N/T	10/4	18	(0.5)
Car Can Be Pedaled At 15 mph	N/T	1/25	8	(0.8)
Wheels Within Wheels Provide Infinitely Variable Speed Ratios	Scan	5/31	38	(1.0)
Packaged Adjustable-Speed Drives: Belt and Chain Drives	Malcolm	MD 6/21	93	(1.6)
Hemisphere Varies Shaft Velocity Ratio	Scan	5/3	48	(0.7)
Packaged Adjustable-Speed Drives: Friction and Traction Drives	Burnett	MD 6/21	95	(1.7)
Traction Drive Shows Automotive Promise	Kraus	10/18	20	(4.0)
Traction Drive Uses Planetary Geometry	Scan	10/18	46	(1.0)
Packaged Adjustable-Speed Drives: Gear Drives	Wadlington	MD 6/21	92	(1.5)
Chains	Peck	MD 6/21	9	(2.0)
Belts: V-Belts	Nuernberger	MD 6/21	26	(2.7)
Belts: Flat Belts	Zaiss	MD 6/21	28	(2.3)
Belt Drive Bites Into Chain Applications	Scan	12/27	34	(1.0)
Gears and Gear Drives: Gears	Crawshaw & Kron	MD 6/21	38	(4.8)
Shifting to Metric Gears	Buchsbaum	8/9	94	(4.0)
How To Get High-Accuracy Plastic Gears	Theberge, Cloud & Arkles	9/6	140	(6.0)
Self-Locking in a Worm-Gear	Jordan	10/18	166	(2.0)
Rediscovering the Noncircular Gear	Cunningham	11/1	80	(6.0)
How To Design Noise Out of Gears	Bradley	12/13	149	(5.0)
Derailleur Derailed by Powder Metal Sprocket	Scan	10/4	43	(0.5)
Belts: Pulleys	Zaiss	MD 6/21	31	(0.6)
Multimagnet Belt Sorts Metals from Shredded Solids	N/T	8/23	6	(0.5)
Reversed-Thread Screw Stirs Molten Polymers	Scan	8/23	43	(0.5)

## 35. Rotational Components

AFBMA Requests Fair International Trade	N/T	6/28	4	(0.5)
The Big Difference in Large Bearings	Dobson	8/23	120	(5.0)
Taming Rotor Whirl With Film-Damper Bearings	Giberson	3/22	176	(6.0)
Rerate Tilting-Pad Thrust Bearings	Malanoski	5/3	100	(4.0)
Rocks Ride on Air	Scan	6/14	66	(0.5)
Helical Bearing Screws Into Socket	Scan	6/28	44	(0.6)
Magnetic Bearings Support Satellite Flywheel	Scan	9/20	39	(0.6)
New Thrust in Journal Bearings	Scan	11/15	47	(0.6)
Couplings	Summers MD	6/21	156	(3.0)
Universal Joints	Chapter MD	6/21	165	(2.0)
Auxiliary Components: Flexible Shafts	Zambetti MD	6/21	172	(2.0)
The 'Forgotten' Forces in Couplings	Ferguson & Woodruff	9/6	146	(5.0)
Packaged Adjustable-Speed Drives: Torque Converters	Wirry	MD 6/21	96	(2.0)
Clutches and Brakes: Fluid Couplings	Chapter MD	6/21	135	(1.1)
Critical Speeds for Cantilever Shafts	Batori	6/28	95	(4.0)
Tool's Torque Adjusted with Sine-Wave Clutch	Scan	4/19	134	(0.8)
Clutches and Brakes: Mechanical Clutches	Cozzarin MD	6/21	130	(2.3)
Clutches and Brakes: Mechanical Brakes	Keller MD	6/21	136	(1.4)
Stopping in the Name of the Law	Bryson	7/26	20	(5.0)
How DOT 121 Affects Truck Design	N/T	11/15	10	(0.6)
Tiny Fan Sucks Away Those Hairly Problems	Scan	5/3	52	(0.5)
Inside-Out Propeller Can't Clog	Scan	7/26	44	(0.6)
Packing the Maximum Fan in the Minimum Space	Chardon & Roy	9/20	152	(5.0)
Resilient Hub Hushes Fan	Scan	12/27	35	(0.5)
The Revolution in Flywheels	Dann	5/17	130	(6.0)
Counterweights for Rotating Machine Elements	Barrows	12/13	172	(1.7)

## 36. 37. Mechanisms, Controls

Self-Thread Cartridge Takes Touch Out of Ribbon Changes	Scan	2/22	116	(1.0)
Specialized-Motion Components: Cams	Chapter MD	6/21	174	(1.0)
Controlling a Sequenced Operation	Boulden & Engstrom	2/22	101	(5.0)
Simple Guide Provides Testing Precision	Scan	4/5	131	(0.5)
The Robots Are Coming—Automation's Finest Hour?	Scan	5/17	46	(0.5)
Rolling Rings Reel Rope	Scan	7/26	42	(0.6)
Field-Tested Birdwagen Begins Traversing The Globe	N/T	1/25	12	(0.5)
Controller Helps Paralyzed Help Themselves	N/T	4/19	12	(0.8)
Double Shuffle Shifts Parts	Scan	11/15	42	(0.7)
Mechanical Drive May Be Wave of Future	Scan	11/15	42	(0.5)
Transmission Fidelity in Push-Pull Controls	Gillmore	7/26	82	(4.0)
Timing and Counting Devices: Counters	Bonneau EC	4/26	107	(4.0)
More Than Just Counting	Bassi	10/4	144	(8.0)
Counters Square Off in Industrial Arena	Bassi	12/27	61	(4.0)

# ASSEMBLY COMPONENTS

## 41, 42, 43. Fasteners, Springs & Isolation Devices, Misc.

Fastener Van Hits The Road	N/T	1/11	12	(0.5)
Going Metric: Fasteners	Spro	3/8	M-11	(6.0)
What's Available Today in Metric Fasteners?	Michalec & Buchsbaum	8/23	107	(3.0)
Trends and Design: Materials	Article F&J	11/22	3	(1.5)
Trends and Design: Finishes and Coatings	Article F&J	11/22	4	(1.9)
Nuts and Inserts: Inserts	Braendel	F&J 11/22	70	(1.5)
Nuts and Inserts: Captive Nuts: Anchor Nuts	Mihaly	F&J 11/22	64	(1.5)
Nuts and Inserts: Captive Nuts: Caged Nuts	Seltz & Petrus	F&J 11/22	65	(1.0)
Nuts and Inserts: Captive Nuts: Clinch Nuts	Massey	F&J 11/22	66	(1.0)
Nuts and Inserts: Captive Nuts: Self-Piercing Nuts	Steward	F&J 11/22	67	(1.0)
Nuts and Inserts: Single-Thread Nuts	Seltz & Petrus	F&J 11/22	68	(1.8)
Nuts and Inserts: Locknuts	Article F&J	11/22	69	(0.5)
Plns	Broendel	F&J 11/22	92	(2.0)
Special-Purpose Fasteners: Quick-Operating Fasteners	Barry	F&J 11/22	139	(3.0)
Look Ma, No Hands	Scan	12/13	44	(0.6)
Cable Strain Collar Takes No Space	Scan	9/6	50	(0.5)
Retaining Rings: Stamped Rings	Wurzel	F&J 11/22	120	(1.0)
Retaining Rings: Wire-Formed Rings	Miller	F&J 11/22	121	(1.0)
Retaining Rings: Spiral-Wound Rings	Berkbiller	F&J 11/22	123	(1.5)
Riveting the Noiseless Way	Dreger	6/28	74	(6.0)
Hypocycloidal Riveter Strengthens Rivet Heads	Scan	9/6	48	(0.5)
Rivets and Riveting Processes: Rivets	Chapter	F&J 11/22	98	(1.5)
Rivets and Riveting Processes: Blind Rivets	Chapter	F&J 11/22	99	(1.5)
Screws, Bolts, and Studs: Tapping Screws	Article F&J	11/22	13	(2.0)
Screws, Bolts, and Studs: Setcrews	Trilling	F&J 11/22	15	(2.5)

Screws, Bolts, and Studs: Locking Screws and Bolts	Article F&J	11/22	17	(0.6)
Screws, Bolts, and Studs: Studs	Buzek	F&J 11/22	18	(0.9)
Selecting Spring Washers	Bohm	7/12	127	(5.0)
Selecting Cylindrically Curved Washers	Hopp	10/4	163	(1.8)
Washers	Wagner	F&J 11/22	86	(2.0)
Analyzing Spring Clips	Paulsen	4/5	127	(3.0)
Pliable Strips Zip Fabric to Metal	Scan	5/9	42	(1.0)
Selecting Cylindrically Curved Washers	Hopp	10/4	163	(1.8)
Welded Fasteners: Resistance - Welded Fasteners	Schaff	F&J 11/22	128	(1.5)
Welded Fasteners: Arc-Welded Studs	Singleton	F&J 11/22	129	(1.5)
Special - Purpose Fasteners: Plastic Fasteners	Chapter	F&J 11/22	132	(2.9)
Special-Purpose Fasteners: Spring Clips	Seltz & Petrus	F&J 11/22	134	(2.7)
Special-Purpose Fasteners: Self-Sealing Fasteners	Chapter	F&J 11/22	137	(1.3)
In Search of the Self-Locking Fastener	Scan	12/13	43	(0.5)
Tolerances for Springs	Grudee	2/22	106	(5.0)
Plastic Springs Actuate Fluid Valves	Scan	4/19	136	(0.5)
The Cantilever Beam as an Engineering Tool	Valentich	9/6	151	(2.0)
Taming Rotor Whirl With Film-Damper Bearings	Giverson	3/22	176	(6.0)
Two New Looks in Vehicle Springs	Scan	4/19	132	(1.0)
Rubber Vibration Mounts	Siwiecki	7/26	86	(6.0)
Cylinder Controls Drive Spring	Scan	2/8	148	(0.7)
Cushioning Cylinders	Kunda	4/19	120	(5.0)
Make Your Car into an Extrusion Machine	Scan	12/27	35	(0.5)
Soft Face And Rear Tried on Experimental Autos	N/T	4/5	10	(0.5)
Stopping Vibration with Dynamic Dampers	Khol	8/23	125	(5.0)
Magnetic Lock Fights Crime	Scan	11/29	41	(0.6)
Off-The-Shelf Packaging for Electrical Equipment	Herzog	8/9	88	(6.0)
Urethane-Filled Tire Tested At 120 mph	N/T	3/8	8	(0.7)
Automaker Uses Window-Curtain Effect to 'Map' Tire Contours	N/T	8/23	10	(0.6)
After the Radial, What?	Bryson	11/1	20	(4.0)
Getting the Most From Equipment Slides	Herzog	10/4	161	(2.0)



## 49. General

Dimensional Accuracy—What It Is. How to Get It.—Part 1	Bittence	6/14	144	(7.0)
Dimensional Accuracy—What It Is. How to Get It.—Part 2	Bittence	6/28	90	(5.0)

# MATERIALS

## 51, 52. Ferrous, Nonferrous Metals

Trends and Design: Materials	Article	F&J 11/22	3	(1.5)
Reaching for Deep-Ocean Metals	Bryson	6/28	20	(6.0)
New Hardenability Data For Pre-alloyed P/M Steels	Article	5/17	149	(2.3)
Reaching for Deep-Ocean Metals	Bryson	6/28	20	(6.0)
Coming: All-Aluminum Automobile Body?	N/T	2/8	27	(0.5)
Huge LNG Spheres Slated For Super-tankers	N/T	5/17	28	(0.5)
Factory-Built Home Personalized By Modular Design	N/T	6/28	18	(0.5)
New Copper Provides Long-Sought Properties	N/T	6/28	18	(0.5)
New Alloy Fights Corrosion and Wear	Cameron & Ferriss	8/9	102	(5.0)

## 53, 54. Plastics, Rubber & Elastomer

Selecting Plastics	Benkelman	P 2/15	1	(5.0)
The Almost All Plastic Bicycle	Article	4/5	32	(2.0)
Do OSHA Regulations Affect Selection of Plastics?	Dreger	4/5	105	(3.0)
Forged Plastic Parts	Kulkarni	5/3	94	(6.0)
Accelerated Weathering Tests	Dreger	11/29	61	(7.0)
The Many Faces of Polyethylene	Longarzo & Margolies	1/11	113	(5.0)
Thermoplastic Resins: ABS	Chapter	P 2/15	7	(2.3)
Thermoplastic Resins: Acetals—Acetal Homopolymers	Hall	P 2/15	9	(1.0)
Thermoplastic Resins: Acetals—Acetal Copolymers	Roebright	P 2/15	10	(1.0)
Thermoplastic Resins: Acrylics	Gambino	P 2/15	11	(1.7)
Thermoplastic Resins: Celluloses	Chapter	P 2/15	13	(1.2)
Thermoplastic Resins: Chlorinated Polyether	Chapter	P 2/15	14	(0.7)
Thermoplastic Resins: Ethylene - Vinyl Acetate	Kowal	P 2/15	15	(0.7)
Thermoplastic Resins: Fluoroplastics—TFE, FEP, PFA Fluorocarbons	McCane	P 2/15	16	(2.1)
Thermoplastic Resins: Fluoroplastics—ETFE, ECTFE Fluoropolymers	Chapter	P 2/15	18	(0.3)
Thermoplastic Resins: Fluoroplastics—CTFE Resins	Burns	P 2/15	18	(1.3)
Thermoplastic Resins: Ionomers	Conwell	P 2/15	19	(0.5)
Thermoplastic Resins: Nylons	Carswell	P 2/15	20	(1.5)
Thermoplastic Resins: Phenylene Oxide Based Resins	Young	P 2/15	23	(1.0)
Thermoplastic Resins: Polyallomers	Vermillion	P 2/15	24	(0.7)
Thermoplastic Resins: Polycarbonates	Cooney	P 2/15	24	(1.2)
Thermoplastic Resins: Polyesters	Chapter	P 2/15	26	(1.0)
Thermoplastic Resins: Polyethylenes	Margolies & Longarzo	P 2/15	28	(1.2)
Thermoplastic Resins: Polyimides	Campbell & Melvin	P 2/15	30	(1.5)
Thermoplastic Resins: Polypropylenes	Houston	P 2/15	32	(1.2)
Thermoplastic Resins: Polystyrenes	Glass	P 2/15	33	(1.5)
Thermoplastic Resins: Polysulfones	Walton	P 2/15	36	(1.0)
Thermoplastic Resins: Polyvinyl Chlorides (PVC)	Bulkley	P 2/15	38	(2.3)
Reinforced Plastics: Reinforced Thermoplastics	Lachowick	P 2/15	95	(3.1)
Structural Parts from Plastic Foams	Dreger	5/17	136	(7.0)
How To Get High-Accuracy Plastic Gears	Theberge, Cloud & Arkles	9/6	140	(6.0)
New Self-Lubricating Plastics Are Slipperier and Wear Better	Theberge, Arkles & Goodhue	12/27	58	(3.0)
Reinforced Plastics: Reinforced Thermosets	Zenk & Davis	P 2/15	98	(1.7)
Thermosetting Resins: Alkyls	Chapter	P 2/15	104	(1.0)
Thermosetting Resins: Allylics	Kelley	P 2/15	105	(1.5)

Torque Wrench Checks Cable Tension	Scan	9/20	42	(0.5)
Rotating Magnets Measure Angular Acceleration	Scan	9/20	42	(0.5)
Errors From Misaligned Strain Gages	Article	9/20	170	(1.5)
Flexure Pivots Make Rugged Lab Balance	Scan	11/1	36	(1.0)

Thermosetting Resins: Aminos	Sunderland, Nufer & Schupp	P 2/15	106	(1.5)
Thermosetting Resins: Epoxies	Clearwater	P 2/15	109	(1.5)
Thermosetting Resins: Phenolics	Bainbridge	P 2/15	110	(2.0)
Thermosetting Resins: Polyesters	Updegraff	P 2/15	113	(1.7)
Thermosetting Resins: Silicones	Raum	P 2/15	115	(1.3)
Thermosetting Resins: Urethanes	Ostfield & Prepelka	P 2/15	116	(2.2)
Urethane-Filled Tire Tested At 120 mph	N/T	3/8	8	(0.8)
Laminated Plastics	Muller	P 2/15	128	(3.0)
Metal/Plastic Laminates	Tonnesen	3/22	166	(4.0)
Reinforced Plastics: Reinforced Thermoplastics	Lachowick	P 2/15	95	(3.1)
Reinforced Plastics: Reinforced Thermosets	Zenk & Davis	P 2/15	98	(1.7)
Degradable Plastics	Sproh	5/31	76	(5.0)
Rubber Vibration Mounts	Siwiecki	7/26	86	(6.0)
A Fresh Look at Elastomers Today	King	1/25	106	(7.0)
Elastomers: Thermoplastic Elastomers	Wells	P 2/15	161	(3.0)
Elastomers	King	P 2/15	164	(4.0)
Rubber That Doesn't Act Natural	Hall	7/12	109	(7.0)

## 55, 56. Joining Materials, Other Nonmetals

Sealants	Chapter	8/9	134	(4.0)
Adhesives	Sharpe	F&J 11/22	182	(4.0)
Resistivity of Silver Brazing Alloys	Reichenecker	10/18	168	(2.0)
Low-Loss Light Fiber Fabricated From Single Glass	N/T	7/12	6	(0.5)
When Glass Parts Fail	Shoemaker	12/13	154	(5.0)
Portable Football Field Rolls Up After The Game	N/T	2/22	18	(1.0)
Silencing the Noisy Hydraulic System	Miller	6/14	138	(6.0)
Baggage Bulls-Eyes and Green-Glow Stamps Trigger Handling Systems	N/T	12/27	10	(0.5)
Looking into Liquid-Crystal Displays	Article	11/29	84	(1.0)

## 57. Finishes, Coatings, Lubricants

Trends and Design: Finishes and Coatings	Article	F&J 11/22	4	(1.9)
Mechanical Plating: Safe and Sure Protection For Critical Parts	Bremner	9/20	162	(5.0)
Powder Paint Solves Some Car-Finishing Problems	N/T	2/8	8	(0.7)
Guide to Solid Lubricants	Article	6/14	157	(1.0)
New Self-Lubricating Plastics Are Slipperier and Wear Better	Theberge, Arkles & Goodhue	12/27	58	(3.0)
Specifying a Surface Finish That Won't Fail in Fatigue	Johnson	5/3	108	(1.0)
Specifying Surface Finish	Drehs	6/14	155	(1.3)

## 58. Prefabricated Forms

Unlikely Material Proves Great For Magnetic Bubbles	Article	3/22	40	(2.0)
How to Select Electrical Insulating Tape	Conner	9/20	168	(1.8)
Metal/Plastic Laminates	Tonnesen	3/22	166	(4.0)
Acrylic/Wood Composite Bids For Design Applications	N/T	5/31	12	(0.8)
First Membrane Geodesic Dome Classroom	N/T	2/8	10	(0.5)
The Isogrid—King of Lightweight Design	Slysh	4/19	102	(6.0)
Structural Parts from Plastic Foams	Dreger	5/17	136	(7.0)
Factory-Built Home Personalized By Modular Design	N/T	6/28	18	(0.5)
The Keys to the Corner	Scan	7/12	50	(0.6)
No Tools Needed To Assemble Shelter	N/T	8/9	18	(0.5)
Holey Molder Makes Strong Honeycomb	Scan	12/13	42	(1.0)
The Controversial Sydney Opera House	Article	12/27	30	(2.0)
Porous Tube To Shelter Injured Ner...	N/T	2/8	10	(0.5)

# MANUFACTURING PROCESSES

## 61-63. Metals Casting, Shaping, Forming

Low-Pressure Casting for High-Performance Parts	Sproh	4/5	122	(5.0)
Forged Plastic Parts	Kulkarni	5/3	94	(6.0)
No-Impact Forging	Dreger	10/4	135	(3.0)
Continuous Extruder Mates with Continuous Caster	Scan	10/14	48	(0.7)
Riveting the Noiseless Way	Dreger	6/28	74	(6.0)
Hypocycloidal Riveter Strengthens Rivet Heads	Scan	9/6	48	(0.5)
New Hardenability Data For Pre-alloyed P/M Steels	Article	5/17	149	(2.3)
Porous Pen Continues Drawing A Fine Line	N/T	7/12	18	(0.5)
PM Parts With The Strength of Forgings	Halter & Belden	7/12	116	(6.0)

Designing Printout Mechanisms With 'Solid-Ink' Rollers	Dreger	7/12	132	(1.6)
New Applications Proliferate for PM Parts	N/T	8/23	18	(1.0)
Powder Metallurgy Isn't All Glamour	Article	10/4	167	(1.0)
Redesigning for P/M	Article	11/15	169	(1.0)
Musical Instrument Design	Aronson	7/12	20	(5.0)
Safe Edges For Sheet Metal	Strasser	5/3	109	(1.0)
Draw Depth Doubled With Water Lubrication	N/T	7/12	36	(0.7)
How to Cheat on the Rules for Stamping	Strasser	7/12	136	(0.1)
How to Stamp the "Hole" Thing	Strasser	11/1	103	(1.3)
Explosive Forming	Zernow	8/23	114	(6.0)
Contouring Parts by Stretch and Compression Forming	Brauer	10/18	160	(6.0)



## 64, 65. Metal Joining, Removal

Joining Methods for Small Assemblies...	Prudden	6/14	127	(5.0)
Welding, Brazing, and Soldering: Brazing	Fattee	F&J 11/22	172	(2.4)
Welding, Brazing and Soldering: Soldering	Smith	F&J 11/22	174	(1.5)
Adhesives	Sharpe	F&J 11/22	182	(4.0)
Color—New For Sonic Sewing	N/T	6/28	6	(0.7)
Avoiding Failure in Serrated Joints	Tromel	8/9	106	(3.0)
Trends and Design: Design of Bolted Joints	Osgood	F&J 11/22	6	(4.5)
Rivets and Riveting Processes: Riveting Processes	Chap-ter	F&J 11/22	101	(1.0)
The Search for the Sculptured Surface...	Khol	3/22	154	(7.0)
Mechanical Saws Clear A Channel For Icebreaker	N/T	7/26	10	(0.7)
Abrasive Jet Machining	Lavole	9/6	135	(5.0)
When Grinding Isn't Good Enough	Anderson	11/15	152	(6.0)
Microfinishing Round Surfaces	Bittence	11/29	72	(5.0)
Water-Jet Machining	Lavole	2/22	89	(5.0)

## 66. Metal Treating

Effects of Case Hardening on Tolerances	Deakin	7/26	92	(1.1)
PCM Laminate Beats Thickness Barrier	Scan	4/19	134	(0.5)

## Photochemical Machining Moves Up From The 'Tiny Parts' Image

White 6/14 154 (1.6)

## 67, 68. Finishing, Plastics & Rubber Processes

Finishes for Aluminum	Evans	10/4	156	(5.0)
Mechanical Plating: Safe and Sure Protection For Critical Parts	Bremner	9/20	162	(5.0)
Making Parts With A Plasma-Arc Torch	Bittence	4/19	108	(7.0)
Plastic Parts: Molding and Fabricating	Chapter	P 2/15	132	(4.0)
Plastic Springs Actuate Fluid Valves...	Scan	4/19	136	(0.5)
The Perils of Prototypes	Chastain	11/15	137	(5.0)
Hydraulic Control Drives Injection Molder	Scan	12/13	48	(0.7)
Plastic Parts: Assembly Methods	Chapter	P 2/15	136	(2.0)
Welding Plastics With Hot Air	Kaminsky	5/31	96	(1.3)

## 69. General

Automatic Assembly	Chapter	F&J 11/22	160	(2.0)
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# DESIGN THEORY & TECHNIQUES

## 71-73. Mechanics, Strength of Materials and Parts

Beams on Flexible Supports	Sofronas	8/23	131	(1.7)
Limit Analysis	Jones	9/20	145	(6.0)
Acceleration Time for Motor Drives	Halasz	7/12	133	(1.5)
Finding Forces for Hydraulic Cylinders	Kuhnke	11/1	102	(1.7)
Taming Rotor Whirl With Film-Damper Bearings	Giberson	3/22	176	(6.0)
Flow-Induced Vibrations in Heat Exchangers	Kissel	5/3	104	(4.0)
Stopping Vibration With Dynamic Analysis	Hawkins	5/31	86	(6.0)
Stopping Vibration With Dynamic Dampers	Khol	8/23	125	(5.0)
Computer Shakes Out Bad Race Vibes	N/T	9/6	31	(0.6)
Analyzing the Sounds of Trouble	Herzog	9/6	129	(7.0)
How to Shake a Mathematical Model	Polma	10/18	137	(5.0)
Analyzing Rotor Whirl	Fitzgeorge	11/15	166	(2.0)
Let Resonance do Your Fatigue Testing	Love	11/29	82	(1.2)
Counterweights for Rotating Machine Elements	Barrows	12/13	172	(1.7)
Airports You Can Live With	Bryson	2/8	20	(5.0)
Pinpointing Noise With Sound-Level Meters	Herzog	4/5	108	(6.0)
Coming: Standards For Acceptable Impact Noises	N/T	6/14	12	(0.6)
Forecasting Failures with Acoustic Emission	Herzog	6/14	132	(6.0)
Silencing the Noisy Hydraulic System	Miller	6/14	138	(6.0)
Noise Pollution in the Engineering Office	Herzog	7/26	66	(6.0)
Analyzing the Sounds of Trouble	Herzog	9/6	128	(7.0)
How Noise Affects People	Jacobson	10/18	132	(5.0)
Ecology vs Recreational Boats	Bryson	11/29	20	(4.5)
How To Design Noise Out of Gears	Bradley	12/13	149	(5.0)
Whirling Arm Checks Out Space Shuttle Materials	N/T	6/14	34	(0.6)
Plastic Bending in Tapered Beams	Goldner	10/4	152	(4.0)
Specifying A Surface Finish That Won't Fail in Fatigue	Johnson	5/3	105	(1.0)
Avoiding Failure in Serrated Joints	Tromel	8/9	106	(3.0)
Pressure Ratings Predict Fatigue Life...	Boulden	11/29	81	(1.8)
When Glass Parts Fail	Shoemaker	12/13	154	(5.0)
New Alloy Fights Corrosion and Wear	Cameron & Ferris	8/9	102	(5.0)
Specifying A Surface Finish That Won't Fail in Fatigue	Johnson	5/3	108	(1.0)
Forecasting Failures with Acoustic Emission	Herzog	6/14	132	(5.0)
New Hardenability Data For Pre-alloyed P/M Steels	Article	5/17	149	(2.3)
Shortcuts for Designing Shafts	Borchardt	2/8	139	(3.0)
Tolerances for Springs	Grudee	2/22	106	(5.0)
The 'Forgotten' Forces in Couplings	Woodruff	9/6	146	(5.0)
Photoelasticity Indicates Bolt Tension	Scan	6/14	66	(0.5)
Beams on Flexible Supports	Sofronas	8/23	131	(1.7)
Plastic Bending in Tubular Beams	Goldner	10/4	152	(4.0)
Avoiding Failure in Serrated Joints	Tromel	8/9	106	(3.0)
Heavy Lift Helicopter Blade Spar Completed	N/T	7/26	12	(0.5)
Analyzing Rotor Whirl	Fitzgeorge	11/15	166	(2.0)
Critical Speeds for Cantilever Shafts	Batori	6/28	95	(4.0)

## 74. Human-Factors Engineering

The Engineered Body	Bryson	1/25	20	(7.0)
Beeper Tells Skier To Bend His Knees	N/T	3/8	18	(0.8)
Navy Tries Hydrogen As Diver's Breathing Gas	N/T	6/14	31	(0.5)
VW Simulator Tests New-Car Designs	DI	9/6	42	(1.0)
Designing for OSHA: Operator Safety on Pinch-Point Machines	Sutter	1/11	101	(9.0)
Drunk Tester Makes Sure Driver Can Steer	N/T	1/25	6	(0.7)
Can Technology Survive Bureaucracy? Part One: Who Pulls the Strings?	Wise	2/8	118	(10.0)

## Car-Safety Researchers Tackle Protecting The Pedestrian

Powered Minibikes Judged Hazardous	N/T	3/22	6	(0.7)
An Act You'll Have To Follow	N/T	3/22	26	(0.7)
Engineers Need Product-Liability Protection, Say Experts	Klein	3/22	32	(4.0)
Do OSHA Regulations Affect Selection of Plastics?	Scan	3/22	196	(0.7)
Pinpointing Noise With Sound-Level Meters	Dreger	4/5	105	(3.0)
Inflatable Life Raft Can't Tip Over	Herzog	4/5	108	(6.0)
Is Your Hydraulic System Fire-Safe?	N/T	4/19	34	(0.5)
What's Your Product Safety Profile?	Sproh	5/17	143	(6.0)
Escape Slide Operational On Offshore Platforms	Cinibulk	5/31	70	(6.0)
Drunk-Driver Prevention	N/T	6/14	31	(0.5)
Product Safety Guardian Issues Warnings	Wise	7/12	30	(4.0)
How DOT 121 Affects Truck Design	N/T	9/20	4	(0.7)
Coming: Standards For Acceptable Impact Noises	N/T	11/15	10	(0.6)
How Noise Affects People	N/T	6/14	12	(0.6)
Wrist Device Computes Decompression Stops	Jacobson	10/18	132	(5.0)
Thumb Hinge Now Ready for Implant	N/T	11/29	26	(0.5)
Pilots May Fly By Feel of The Instruments	N/T	8/23	6	(0.5)
	N/T	4/5	6	(0.5)

## 75. Design Analysis & Synthesis

New, Low-Cost Interactive Graphics	Albert	1/25	97	(5.0)
Design Synthesis—A New Approach To Engineering	Johnson	10/18	149	(7.0)
Design Synthesis—Aids to Creative Thinking	Johnson	11/15	158	(6.0)
Design Synthesis—Selecting Materials and Dimensions	Johnson	12/13	164	(6.0)
Simulating Vehicle Impact	Seshadri	12/13	170	(2.0)
Design Synthesis—The Road To Optimization	Johnson	12/27	52	(6.0)
Probabilities Help You Choose the Right Alternative	Herzog	5/3	85	(2.0)
How to Beat the Laws of Probability	Spotts	10/4	164	(2.2)
Acceleration Time for Motor Drives	Halasz	7/12	133	(1.5)
Graphs for Moment of Inertia	Darji	9/6	154	(1.8)
Finding Forces for Hydraulic Cylinders	Kuhnke	11/1	102	(1.7)
Remotely Controlled Model Airplanes	N/T	6/28	12	(0.5)
Testing Military Ideas	DI	9/6	42	(1.0)
VW Simulator Tests New-Car Designs	Polma	10/18	137	(5.0)
How to Shake a Mathematical Model	Lavole	11/1	74	(6.0)
Foiling the Computer Thief	Article	7/26	96	(1.0)
How Quality Control Can Help the Designer	Spotts	10/4	164	(2.2)
How to Beat the Laws of Probability	Brandt	2/22	111	(3.0)
How Not to Use Statistical Dimensioning	Ripfel	5/3	87	(4.0)
Stripping the Mystery from Metric Tolerances	Bittence	6/28	90	(5.0)
Dimensional Accuracy—What It Is, How to Get It—Part 2	Deakin	7/26	92	(1.1)
Effects of Case Hardening on Tolerances	Spahr & Tibbetts	8/9	111	(1.7)
Can Dimensional Tolerance be Too Wide?	Spotts	9/20	157	(5.0)
Dimensioning Parts So They Fit	Spotts	10/4	164	(2.2)
Limit Analysis	Jones	9/20	146	(6.0)

## 76. Basic Sciences & Fields

U. S., Soviets Initiate Cooperative Research	N/T	4/19	32	(0.5)
The Controversial Sydney Opera House	Article	12/27	30	(2.0)
Element 104 Conclusively Identified	N/T	6/28	30	(0.8)
Infrared—Ultraviolet	Khol	5/17	124	(6.0)
The Engineered Body	Bryson	1/25	20	(7.0)
Porous Tube-To Shelter Injured Nerve	N/T	2/8	10	(0.5)
Autotransfusion Recycles Blood	Klein	2/8	32	(2.0)
Controller Helps Paralyzed Help Themselves	N/T	4/19	12	(0.8)
Ultrasonic Camera Looks Into Human's Body	N/T	5/31	8	(0.5)

Researchers Study How Brain, Skull React To Blows	N/T	5/31	18	(0.5)
Thumb Hinge Now Ready for Implant	N/T	8/23	6	(0.5)
New Technologies Spur Advances in Medical Instrumentation	N/T	12/27	8	(0.7)
Picking an Oscilloscope Camera	Herzog	1/11	108	(5.0)
Practical Jobs for Optical Computers	Jensen	2/22	94	(7.0)
'Stopping' Rotary Motion With a Prism	Waddell	5/17	151	(1.0)
Photoelasticity Indicates Bolt Tension	Scan	6/14	66	(0.5)
Simple Optics for Photoelectric Control	Chandler	9/20	140	(6.0)
Phantom Photography To Provide Two-Color Pictures of Jupiter	N/T	12/13	6	(1.0)
Ultrasonic Camera Looks Into Human's Body	N/T	5/31	8	(0.5)
Tall Buildings and the Wind	Morse	1/11	24	(4.0)
Outside Service for In-House Instruments	Herzog	8/23	133	(0.7)
The Economics of Buying New Machinery	Reiser	9/6	118	(6.0)
Tapered Wing Improves Small-Plane Aerodynamics	N/T	11/29	12	(0.5)

## 77. Experimental Design

Gas-Turbine Prototypes Keep Running	Article	7/12	135	(0.8)
The Perils of Prototypes	Chastain	11/15	137	(5.0)
Graphs for Moment of Inertia	Darji	9/6	154	(1.8)
Limit Analysis	Jones	9/20	146	(6.0)

## 78. Environmental Design

Accelerated Weathering Tests	Dreger	11/29	61	(7.0)
New Alloy Fights Corrosion and Wear	Cameron & Ferriss	8/9	102	(5.0)

Filling Hydraulic Circuits with Seawater	Article	12/13	173	(1.3)
Saturn Moon Has Earth-Similar Atmosphere	N/T	1/25	16	(0.5)
OAO-2 Shut Down: End Of The Line For A Very Successful Spacecraft	N/T	3/22	26	(0.5)
First Instrumented Balloon Orbiting Rugged Recorder Tested for Mars Lander	N/T	4/19	8	(0.5)
NASA Adopts New Approach To Lunar Studies	N/T	4/19	34	(0.5)
'Thinking' Satellite Will Always Know Its Position	N/T	6/28	8	(0.5)
Phantom Photography To Provide Two-Color Pictures of Jupiter	N/T	12/13	6	(1.0)
Deep-Water Anchor Blasted Into Bottom	N/T	2/22	10	(0.8)
Dollars in the Deep	Bryson	5/3	18	(5.0)
Reaching for Deep-Ocean Metals	Bryson	6/28	20	(6.0)
Opening the Ocean Frontiers	Bryson	12/27	18	(6.0)
Pollution Controller Improves Performance	N/T	1/25	16	(0.5)
National Academy of Sciences Voices Doubts	N/T	3/22	31	(0.7)
Progress Called Slow On Auto Emission Controls	N/T	4/5	34	(0.8)
Electric Vehicles Designated Low Emitters	N/T	5/17	18	(0.7)
Light Having Trouble Penetrating the Atmosphere	N/T	7/12	10	(0.8)
Automakers To Get Relief From Nitrogen Oxide Standard	N/T	7/12	18	(0.5)
Noise Pollution in the Engineering Office	Herzog	7/26	66	(6.0)
Emissions Slashed by Fuel Reformer	Scan	8/9	42	(0.7)
Ecology vs Recreational Boats	Bryson	11/29	20	(4.5)

# ENGINEERING MANAGEMENT & OPERATION

## 81. Engineering Department Operations

Engineering and Purchasing: Partners in Design	Herzog	8/23	102	(5.0)
How Much Will That New Product Cost? Systems Analysis	Watson	4/19	96	(6.0)
The Shoestring Approach to Rating New Products	Safliuddin	1/11	92	(7.0)
Is Engineering An "Equal-Opportunity Employer?"	Murdick & Karger	1/25	86	(4.0)
'Guidelines': A Step Toward Solving Engineers' Problems	Safliuddin	1/25	90	(7.0)
Is Engineering An "Equal-Opportunity Employer?"	Lavoie	1/11	86	(6.0)
Is Management Training Worthwhile?—Bigger Market Reported For New Technical Grads	N/T	5/31	4	(1.2)
Can Technology Survive Bureaucracy?—Professional on a Yo-Yo	Lavoie	1/11	86	(6.0)
'Guidelines': A Step Toward Solving Engineers' Problems	Imberman	3/22	150	(4.0)
A Good Sign: Engineers Wanted	N/T	4/5	4	(0.8)
More Pay Asked For Federal Engineers	Lavoie	5/17	118	(6.0)
Salaries Spurt in Bidding Battle for '73 Graduates	N/T	5/31	4	(1.2)
Is Management Training Worthwhile?—Make Yourself Promotable	Lavoie	6/28	66	(8.0)
To Be A Successful Supervisor	N/T	7/26	4	(0.5)
Don't Overlook the Secretarial Route to Management	N/T	12/27	4	(1.2)
Salary Survey Reveals Several Surprises	Imberman	3/22	150	(4.0)
A Look at Salaries for Australian Engineers	Mead	5/3	82	(3.0)
Salaries Spurt in Bidding Battle for '73 Graduates	Bickford	8/9	84	(4.0)
	N/T	10/4	4	(0.5)
	N/T	10/18	4	(0.8)
	Scholes	10/18	42	(0.7)
	N/T	12/27	4	(1.2)

## 82, 83. New Product Development, Drafting & Reproduction

Can Technology Survive Bureaucracy?				
Part One: Who Pulls the Strings?	Wise	2/8	118	(10.0)
Soviet Technology Review	Aronson	2/22	20	(5.0)
The Energy Crisis Can Be Solved	Article	2/22	28	(4.0)
\$30.1 Billion To Be Spent For R&D This Year	N/T	3/22	18	(0.5)
Can Technology Survive Bureaucracy?—Part Two: Uncle Sam at the Helm	Khol	4/5	98	(7.0)
Steel Designs Blend Tradition	Article	4/19	30	(2.0)
How Much Will That New Product Cost?	Watson	4/19	96	(6.0)
Probabilities Help You Choose the Right Alternative	Herzog	5/3	85	(2.0)
Cooperative R&D	Aronson	5/31	26	(2.0)
Can Technology Survive Bureaucracy?—Part Four: Models for Change	Boulden	7/12	104	(5.0)
R&D to Top \$30 Billion in '73	N/T	8/9	4	(0.8)
Feds Crank Up To Help 'Small' Innovator	Jacobson	10/4	130	(5.0)
Cars Can Last 20 Years, Says Porsche	Article	11/1	30	(1.0)
Soviet Technology Tackles Internal Problems	Article	11/15	20	(5.0)
Make Press-On Symbols Yourself	Scan	8/23	48	(0.5)
Conversion Slide Rules Speed Metric Changeover	Boulden	8/23	130	(1.5)
Association Standards Available On Microfilm	N/T	6/28	28	(0.6)

## 84. Laboratory & Testing

Huge Rig Tests Aircraft Engines	N/T	2/8	18	(0.5)
Let Someone Else Test It	Sprow	2/8	128	(6.0)
How To Catch a Transient	Herzog	3/22	170	(6.0)

First Instrumented Balloon Orbiting	N/T	4/19	8	(0.5)
Scale Model Proving Viking's Design	N/T	4/19	32	(0.5)
Test Man When Testing New Products	N/T	5/3	26	(0.6)
Researchers Study How Brain, Skull React To Blows	N/T	5/31	18	(0.5)
Stopping Vibration With Dynamic Analysis	Hawkins	5/31	86	(6.0)
Whirling Arm Checks Out Space Shuttle Materials	N/T	6/14	34	(0.6)
Forecasting Failures with Acoustic Emission	Herzog	6/14	132	(6.0)
Drunk-Driver Prevention	Wise	7/12	30	(4.0)
Gas-Turbine Prototypes Keep Running	Article	7/12	135	(0.8)
Heavy Lift Helicopter Blade Spar Completed	N/T	7/26	12	(0.5)
Automaker Uses Window-Curtain Effect to 'Map' Tire Contours	N/T	8/23	10	(0.6)
Computer Shakes Out Bad Racer Vibes	N/T	9/6	31	(0.6)
VW Simulator Tests New-Car Designs	DI	9/6	42	(1.0)
Analyzing the Sounds of Trouble	Herzog	9/6	128	(7.0)
When You Can't Justify New Test Equipment	Herzog	10/18	142	(7.0)
Accelerated Weathering Tests	Dreger	11/29	61	(7.0)
Let Resonance do Your Fatigue Testing	Love	11/29	82	(1.2)

## 85. Technical Information

Picking Uncle Sam's Brain	Herzog	9/20	132	(8.0)
Ironbridge Gorge Museum	Morse	10/4	20	(5.0)
Going Metric: Why?	Boulden	3/8	M-3	(8.0)
Going Metric: Fasteners	Sprow	3/8	M-11	(6.0)
Going Metric: Fluid Power	Long	3/8	M-17	(6.0)
Going Metric: Electronics	Leonard	3/8	M-23	(6.0)
Going Metric: Mechanical Drives	Zimmerman & Lavoie	3/8	M-29	(8.0)
	Gat	3/8	M-35	(4.0)
Going Metric: The System	Ripfel	5/3	87	(4.0)
Stripping the Mystery from Metric Tolerances	N/T	6/14	12	(0.6)
Coming: Standards For Acceptable Impact Noises	Dreus	6/14	155	(1.3)
Specifying Surface Finish	N/T	6/28	28	(0.6)
Association Standards Available On Microfilm	N/T	7/12	26	(0.5)
Ford Goes Metric With Mass-Produced Engine	N/T	8/9	94	(4.0)
Shifting to Metric Gears	N/T	8/9	110	(1.3)
The Great Bar Fight	Michalec & Buchsbaum	8/23	107	(3.0)
What's Available Today in Metric Fasteners	Boulden	8/23	130	1.5)
Conversion Slide Rules Speed Metric Changeover	Boulden	10/18	132	(5.0)
How Noise Affects People	Jacobson	11/29	81	(1.8)
Pressure Ratings Predict Fatigue Life	Boulden	11/29	74	(6.0)
Folling the Computer Thief	Lavoie	11/29	74	(6.0)

## 86, 87. Patents & Patent Law, Personal Professional

Feds Crank Up To Help 'Small' Innovator	Jacobson	10/4	130	(5.0)
Loyalty... What's It Worth?	Strange	2/22	84	(5.0)
New Technology Incentives Program Launched	N/T	6/28	4	(0.5)
Feds Crank Up To Help 'Small' Innovator	Jacobson	10/4	130	(5.0)
Overcoming Objections to Your Ideas	Herzog	11/29	58	(3.0)
Innovation Is Theme of 1973 Design Show	Scan	3/22	190	(0.8)
Fewer Technology Degrees Likely In Future	N/T	3/8	4	(0.7)
The Prestige Way to Moonlight: Be An Expert Witness	Jacobson	11/15	132	(5.0)

## 88. Outside Services

When You Can't Design It Yourself . . . .	Wainright	6/14	125	(3.0)
Contract Engineers: Alternative to Hiring	Bing	12/13	132	(4.0)
Outside Service for In-House Instruments	Herzog	8/23	133	(0.7)

# COMPLETE MACHINES

## 911. Ordnance

Unique Brazilian APC Debuts . . . . .	Ogorkiewicz	4/5	29	(1.0)
Zap, You're Dead! . . . . .	DI	4/19	40	(1.0)
The A-10: Low-Cost, Lethal, and Rugged	Aronson	11/15	30	(3.0)

## 912. Machinery

Air Cushion Floats The Work To The Machine Tool . . . . .	N/T	3/8	28	(1.0)
Low-Cost Mini Tunnels . . . . .	Morse	4/5	27	(1.0)
Reaching for Deep-Ocean Metals . . . .	Bryson	6/28	20	(6.0)
Air Flow Makes Powders into Fluids .	Scan	10/18	52	(0.6)
Trees Felled and Stripped by Hydraulic Harvester . . . . .	Scan	11/29	40	(1.0)
Hydraulic Control Drives Injection Molder	Scan	12/13	48	(0.7)

## 913. Electrical Machinery

Natural-Sounding Voice Synthesized Electronically . . . . .	N/T	7/26	26	(0.5)
Slides Speak with Magnetic Tape . . . .	Scan	9/20	38	(1.0)
Fooling the Computer Thief . . . . .	Lavoie	11/1	74	(6.0)
Two-Way Voice Link is Built Into Fire/Police Alarm . . . . .	N/T	11/29	12	(0.5)

## 914. Transportation

Rear-Engine Chassis Designed For Motor Homes . . . . .	N/T	1/11	8	(0.5)
How Northern Europe Breaks the Ice . .	Aronson	1/11	18	(3.0)
Car Can Be Pedaled At 15 mph . . . . .	N/T	1/25	8	(0.8)
Coming: A-1-Aluminum Automobile Body?	N/T	2/8	27	(0.5)
Electric Vehicles Put In For Certification	N/T	2/22	12	(0.5)
The Hairiest Race Car Ever Built . . . .	Bryson	3/8	20	(6.0)
Automobilization in the U.S.S.R. . . . .	Article	3/8	36	(2.0)
Simple Vehicle Designed For Developing Nations . . . . .	N/T	3/22	12	(0.8)
Rx for the Old-Car Bug . . . . .	Bryson	3/22	20	(5.0)
Powered Minibikes Judged Hazardous . .	N/T	3/22	26	(0.7)
Unique Brazilian APC Debuts . . . . .	Ogorkiewicz	4/5	29	(1.0)
The Almost All Plastic Bicycle . . . . .	Article	4/5	32	(2.0)
Electric Car Network Planned . . . . .	Heumann	4/5	44	(0.8)
NASA-Army Research Rotorcraft Bids Asked . . . . .	N/T	4/19	18	(0.5)
Charisma on Two Wheels . . . . .	Bryson	4/19	20	(6.0)
Bigger Aircraft Coming In The '80s . .	N/T	5/3	24	(0.5)
Electric Vehicles Designated Low Emitters . . . . .	N/T	5/17	18	(0.7)
Gurney's Eagles Fly at Indy . . . . .	Wise	5/17	20	(6.0)
Electric Bus Features Quick-Change Batteries . . . . .	N/T	5/31	8	(0.5)

Birth of the 100-Knot Navy . . . . .	Aronson	5/31	20	(5.0)
Pulling Six Gs on Plywood Wings . . . .	Bryson	6/14	38	(5.0)
'Rubber Doughnut' Landing Gear Tried on Big Airplane . . . . .	N/E	6/28	10	(0.6)
Remotely Controlled Model Airplanes Testing Military Ideas . . . . .	N/T	6/28	12	(0.5)
Market Researcher Profiles Car Of The 1980s . . . . .	N/T	7/12	12	(0.7)
Tiny Fold-Away Helicopter Flown . . . .	N/T	7/26	6	(1.0)
Commuter Boats To Ski Into New York Automated Transit Shortens Walks For Seattle's Travelers . . . . .	N/T	7/26	18	(1.0)
AMC Shows First of the '74s . . . . .	Wise	8/9	28	(3.0)
Design for Offshore Powerboats . . . .	Bryson	8/23	20	(6.0)
New Mustang in the Ford Corral . . . .	Wise	8/23	30	(3.0)
German High-Speed Railroads . . . . .	Heumann	9/6	20	(6.0)
Cosworth Vega—A Different Kind of Chevrolet . . . . .	Wise	9/6	32	(4.0)
VW Simulator Tests New-Car Designs . .	DI	9/6	42	(1.0)
1974 Car Review . . . . .	Wise	9/20	20	(9.0)
Rocket-Powered Trike . . . . .	Bryson	10/4	30	(3.0)
Federal Gas-Mileage Labeling for Autos Begins This Month . . . . .	N/T	10/4	6	(1.0)
The U. S. Gets Serious About Hydrofoils	Aronson	10/4	30	(4.0)
Cars Can Last 20 Years, Says Porsche .	Article	11/1	30	(1.0)
Prototype Electric Vehicle Debuts . . .	N/T	11/29	10	(0.5)
Ecology vs Recreational Boats . . . . .	Bryson	11/29	20	(4.5)
Germany's Top-Selling 1974 Cars . . . .	Article	11/29	36	(1.0)
Electric Van Begins Two-Year Test . . .	N/T	12/13	10	(0.5)
Opening the Ocean Frontiers . . . . .	Bryson	12/27	18	(6.0)

## 915. Instruments

Pinpointing Noise With Sound-Level Meters . . . . .	Herzog	4/5	108	(6.0)
Probe Measures Flow Direction and Pressure . . . . .	Scan	5/31	39	(0.5)
Musical Instrument Design . . . . .	Aronson	7/12	20	(5.0)
Outside Service for In-House Instruments	Herzog	8/23	133	(0.7)
When You Can't Justify New Test Equipment . . . . .	Herzog	10/18	142	(7.0)
New Technologies Spur Advances in Medical Instrumentation . . . . .	N/T	12/27	8	(0.7)

## 916. Fabricated Metal Products

Tool Box in the Palm of Your Hand . . .	Scan	3/22	185	(1.0)
Tool's Torque Adjusted with Sine-Wave Clutch . . . . .	Scan	4/19	134	(0.8)
Toy Show Previews Christmas of '73 . .	Article	3/22	39	(1.0)
The Latest from Santa's Design Department . . . . .	Aronson	12/13	20	(7.0)



The classification system provides nine major (one-digit) classifications, each of which has up to nine (two-digit) sub-classifications. These, in turn, are divided into ten (three-digit) indexing classifications.

Indexing classifications ending in 0 (General) are used to index material concerning several or all indexing classifications ending in 1 through 8. Classifications ending in 9 (Other) are used for material falling within the sub-classification but not within any of the items 1 through 8.

## 1—ELECTRICAL & ELECTRONIC

- 11 Motors
  - 110 General
  - 111 Fractional (less than 1 hp)
  - 112 Ac integral horsepower
  - 113 Dc integral horsepower
  - 114 Universal (dc and ac)
  - 115 Multispeed
  - 116 Gearmotors
  - 117 Torque
  - 118 Definite and special purpose
  - 119 Other (linear)
- 12 Power Supplies
  - 120 General
  - 121 Batteries (dry and wet)
  - 122 Dc generators, motor-generators
  - 123 Ac generators (alternators), motor-generators
  - 124 Converters, inverters
  - 125 Transformers
  - 126 Fuel cells, solar cells, photo cells
  - 127 Thermoelectric supplies
  - 128
  - 129 Other
- 13 Switches & Relays
  - 130 General
  - 131 Mechanical (pushbutton, lever, rotary, mercury)
  - 132 Thermally operated (thermostats)
  - 133 Pressure operated
  - 134 Limit (snap action)
  - 135 Proximity, photoelectric
  - 136 Stepping
  - 137 Relays, circuit breakers
  - 138 Motor starters (motor controls)
  - 139 Other (reed)
- 14 Instruments & Controls
  - 140 General
  - 141 Sensing devices (transducers, thermocouples)
  - 142 Solenoids, electric actuators
  - 143 Timers, timing motors, delays
  - 144 Synchros
  - 145 Instrument motors (synchronous)
  - 146 Data recorders, readouts, indicators, displays
  - 147 Meters, gages
  - 148 Servo motors, stepping motors
  - 149 Other
- 15 Circuit Components
  - 150 General
  - 151 Resistors (rheostats, potentiometers)
  - 152 Capacitors
  - 153 Inductors
  - 154 Solid-state devices (diodes, transistors, SCR's, rectifiers, semiconductor, integrated circuits)
  - 155 Tubes
  - 156 Saturable reactors (magnetic amplifiers)
  - 157 Fuses
  - 158 Lasers, masers
  - 159 Other
- 16 Connectors & Wiring
  - 160 General
  - 161 Rings, brushes, commutators
  - 162 Terminals, binding posts
  - 163 Contacts (buttons)
  - 164 Plugs, receptacles, connectors, sockets
  - 165 Wiring (cable, cord, coil, harness, bus bars)
  - 166 Printed circuits, stitched circuits
  - 167
  - 168
  - 169 Other (lenses, mirrors, reticles, prisms)
- 17 Miscellaneous Components
  - 170 General
  - 171 Electromagnets, magnets
  - 172 Chassis, control panels
  - 173 Insulation, encapsulation, shielding
  - 174 Cooling elements
  - 175 Lamps, lighting elements (fiber optics)
  - 176 Heaters, heating elements
  - 177 Electric clutches & brakes
  - 178
  - 179 Other
- 19 Systems & Assemblies
  - 190 General
  - 191 Amplifiers, preamps
  - 192 Control systems (regulators, numerical control)
  - 193 Electronic computers, calculators
  - 194 Other electronic
  - 195 Adjustable-speed drives
  - 196 Servomechanisms
  - 197 Other electromechanical
  - 198 Packaging
  - 199 Other

## 2—FLUID POWER

- 21 Fluids
  - 210 General
  - 211 Hydraulic fluids
  - 212 Coolants
  - 213
  - 214
  - 215
  - 216
  - 217
  - 218
  - 219 Other
- 22 Fluid Conditioners
  - 220 General
  - 221 Fluid storage (pressure vessels, reservoirs)
  - 222 Filters, strainers, screens
  - 223 Renovators
  - 224 Heat exchangers
  - 225 Coolers, radiators
  - 226 Heaters
  - 227 Driers
  - 228
  - 229 Other
- 23 Fluid Conductors
  - 230 General
  - 231 Tubing (pressure)
  - 232 Hose
  - 233 Pipe
  - 234 Fittings
  - 235 Joints, couplings, unions
  - 236 Mufflers
  - 237
  - 238
  - 239 Other
- 24 Linear Devices
  - 240 General
  - 241 Cylinders
  - 242 Accumulators
  - 243 Intensifiers
  - 244 Actuators (bellows, diaphragms)
  - 245 Pumps (linear)
  - 246
  - 247
  - 248
  - 249 Other
- 25 Rotary Devices
  - 250 General
  - 251 Pumps (rotary)
  - 252 Fluid motors
  - 253 Air motors
  - 254 Compressors
  - 255 Rotary actuators
  - 256
  - 257
  - 258
  - 259 Other
- 26 Seals
  - 260 General
  - 261 Materials seals (O-rings)
  - 262 Mechanical seals
  - 263 Gaskets
  - 264 Wiper rings
  - 265 Packings
  - 266
  - 267
  - 268
  - 269 Other
- 27 Valves
  - 270 General
  - 271 Direction control
  - 272 Flow control
  - 273 Pressure control (relief)
  - 274 Servo valves
  - 275 Valve blocks (manifolds)
  - 276 Nozzles
  - 277
  - 278
  - 279 Other
- 28 Instruments & Controls
  - 280 General
  - 281 Test stands
  - 282 Control panels
  - 283 Meters, gages
  - 284 Switches
  - 285 Transducers (to hydraulic)
  - 286 Regulators
  - 287 Fluid logic (fluidics)
  - 288
  - 289 Other
- 29 Systems & Assemblies
  - 290 General
  - 291 Industrial hydraulic & pneumatic systems
  - 292 Mobile, aircraft, marine
  - 293 Hydrodynamic drives
  - 294 Hydrostatic drives
  - 295 Vacuum
  - 296 Lubrication
  - 297 Hydraulic, pneumatic computers
  - 298
  - 299 Other

## 3—MECHANICAL

- 31 Power Sources
  - 310 General
  - 311 Jet engines
  - 312 Internal-combustion engines
  - 313 Turbines
  - 314 Atomic, nuclear power
  - 315 Exotic fuel engines (rockets)
  - 316 Fuels, propellants, explosives
  - 317 Steam
  - 318
  - 319 Other
- 32 Constant-Speed Drives & Transmissions
  - 320 General (speed reducers)
  - 321 Chain
  - 322 Belt
  - 323 Friction (ball, disc, wheel, cone)
  - 324 Gear
  - 325
  - 326
  - 327
  - 328
  - 329 Other
- 33 Adjustable-Speed Drives & Transmissions
  - 330 General (speed reducers)
  - 331 Chain
  - 332 Belt
  - 333 Friction (ball, disc, wheel, cone)
  - 334 Gear
  - 335
  - 336
  - 337
  - 338
  - 339 Other
- 34 Drive Components
  - 340 General
  - 341 Transmission chain, cable
  - 342 Belts, belting
  - 343 Gears, gearing, racks
  - 344 Sprockets
  - 345 Pulleys, sheaves, idlers, tensioners
  - 346 Conveyor chain, conveyor cable, conveyor belt
- 347 Conveyor screws
- 348
- 349 Other
- 35 Rotational Components
  - 350 General
  - 351 Antifriction bearings (ball, roller, needle, linear, thrust)
  - 352 Sleeve bearings (gas, solid-lubricant), bushings, rod ends
  - 353 Flexible couplings, universal joints, flexible shafts
  - 354 Torque converters, fluid couplings
  - 355 Shafts, axles, spines, pinions, crankshafts, spindles
  - 356 Clutches, brakes, power absorbers
  - 357 Fans, blowers
  - 358
  - 359 Other
- 36 Mechanisms
  - 360 General
  - 361 Cams
  - 362 Linkages
  - 363 Intermittent-motion (periodic-motion, indexing, mechanical timers)
  - 364 Three-dimensional
  - 365 Motion converters (leadscrews, jacks)
  - 366 Spring motors
  - 367
  - 368
  - 369 Other
- 37 Controls
  - 370 General
  - 371 Push-pull
  - 372 Transducers (to mechanical)
  - 373 Gyros, gyroscopes
  - 374 Counters
  - 375
  - 376
  - 377
  - 378
  - 379 Other
- 39 Systems
  - 390 General

## 4—ASSEMBLY COMPONENTS

- 41 Fasteners
  - 410 General
  - 411 Inserts
  - 412 Nuts, lock nuts
  - 413 Pins, dowels
  - 414 Quick operating (panel-type, latches)
  - 415 Retaining rings, keys, collars
  - 416 Rivets
  - 417 Screws, bolts, studs
  - 418 Washers, grommets, eyelets, spacers
  - 419 Other (spring clips, clamps, zippers)
- 42 Springs & Isolation Devices
  - 420 General
  - 421 Fluid & air springs
  - 422 Helical-wire springs
  - 423 Leaf springs
  - 424 Vibration isolators, mounts
  - 425 Hydraulic-damping devices (shock absorbers, snubbers)
- 426 Mechanical-damping devices
- 427
- 428
- 429 Other (belleville)
- 43 Miscellaneous
  - 430 General
  - 431 Locks
  - 432 Nameplates, labels, wire markers
  - 433 Dials, knobs, handles
  - 434 Shims
  - 435 Enclosures
  - 436 Wheels, tires, rollers, casters
  - 437 Slides, ways
  - 438 Hinges, brackets
  - 439 Other (razor blades, brushes, bells, buzzers)
- 49 General
  - 490 General

## 5—MATERIALS

- 51 Ferrous Metals
  - 510 General
  - 511 Cast iron, malleable iron, cast carbon, alloy steels
  - 512 Wrought carbon, alloy steels
  - 513 Free-machining steels
  - 514 Stainless steels, high alloys, high-temperature steels
  - 515 Specialty steels (tool, die, electrical)
  - 516
  - 517
  - 518
  - 519 Other
- 52 Nonferrous Metals
  - 520 General
  - 521 Aluminum
  - 522 Copper, Brass, Bronze
  - 523 Magnesium
  - 524 Nickel
  - 525 Titanium
  - 526 Zinc
  - 527 Refractory metals (tungsten, tantalum, molybdenum, columbium)
  - 528 Precious metals
  - 529 Other
- 53 Plastics
  - 530 General
  - 531 Thermoplastic plastics (nylon, Teflon)
  - 532 Thermosetting plastics (epoxy, phenolic, filled silicones, rigid urethanes)
- 533 Laminated plastics, vulcanized fiber
- 534 Reinforced, filled plastics
- 535
- 536
- 537
- 538
- 539 Other
- 54 Rubber & Elastomer
  - 540 General
  - 541 Natural rubber
  - 542 Synthetic rubber
  - 543 Elastomeric plastics (flexible silicones & urethanes)
  - 544 Hard rubber
  - 545
  - 546
  - 547
  - 548
  - 549 Other
- 55 Joining Materials
  - 550 General
  - 551 Adhesives, sealants, encapsulants
  - 552 Welding rods
  - 553 Brazing, soldering alloys
  - 554
  - 555
  - 556
  - 557

## 5—MATERIALS (continued)

- 558
- 559 Other
- 56 Other Nonmetals**
- 560 General
- 561 Carbon, graphite, diamonds
- 562 Glass, ceramics
- 563 Refractory materials, mica
- 564 Carbides, cermets
- 565 Mineral & synthetic fibers, felt
- 566 Insulating materials (thermal, sound)
- 567 Wood, cork, composition board, paper
- 568 Chemicals
- 569 Other (abrasives, friction materials)
- 57 Finishes, Coatings & Lubricants**
- 570 General
- 571 Metallic coatings
- 572 Chemical coatings, electrochemical coatings, photosensitive
- 573 Organic finishes (lacquers, synthetic enamels), paints, varnishes
- 574 Porcelain enamels, vitreous coatings
- 575 Plastic coatings
- 576 Lubricating materials
- 577 Cleaners, solvents
- 578
- 579 Other (corrosion inhibitors)
- 58 Prefabricated Forms**
- 580 General
- 581 Film, tape, sheet, foil
- 582 Wire, wire cloth, wire rope, cable
- 583 Patterned, perforated, expanded metals, textured, prefinished plastics
- 584 Laminates (other than laminated)
- 585 Composite materials
- 586 Structures (honeycomb, foam, sandwich)
- 587 Structural shapes (tubing, channels)
- 588 Balls
- 589 Other
- 59 General**
- 590 General

## 6—MANUFACTURING PROCESSES

- 61 Metal Casting**
- 610 General
- 611 Sand
- 612 Shell mold
- 613 Permanent mold
- 614 Centrifugal
- 615 Investment
- 616 Die
- 617
- 618
- 619 Other
- 62 Metal Shaping**
- 620 General
- 621 Forging
- 622 Extrusion, impact extrusion
- 623 Heading, upsetting, cold forming
- 624 Thread, form rolling
- 625 Powder metallurgy
- 626
- 627
- 628
- 629 Other
- 63 Metal Forming**
- 630 General
- 631 Sheet, plate forming
- 632 Stamping, drawing, blanking
- 633 High-velocity forming (explosive forming)
- 634 Spinning
- 635 Roll forming
- 636 Tybe forming
- 637 Wire forming
- 638
- 639 Other
- 64 Metal Joining**
- 640 General
- 641 Arc welding
- 642 Gas welding
- 643 Resistance welding
- 644 High-energy welding (plasma, electron beam, explosive bonding)
- 645 Flame cutting
- 646 Brazing
- 647 Soldering
- 648 Adhesive joining, bonding
- 649 Other (interlocking, keylock, dovetail)
- 65 Metal Removal**
- 650 General
- 651 Planing, broaching
- 652 Lathe, screw machining
- 653 Milling, hobbing, gear shaping
- 654 Drilling, boring
- 655 Grinding, abrasive machining
- 656 Honing, lapping, polishing
- 657 High-energy machining (spark, laser)
- 658
- 659 Other
- 66 Metal Treating**
- 660 General
- 661 Heat treating
- 662 Surface treating (carburizing, nitriding)
- 663 Shot peening, surface working
- 664 Chemical milling, etching
- 665
- 666
- 667
- 668
- 669 Other
- 67 Finishing**
- 670 General
- 671 Chemical, solvent cleaning
- 672 Mechanical finishing
- 673 Conversion coating (anodizing) electro-polishing
- 674 Electroplating, vacuum metallizing
- 675 Metal spraying (flame spraying), hard facing
- 676 Painting
- 677
- 678
- 679 Other
- 68 Plastics & Rubber Processes**
- 680 General
- 681 Molding
- 682 Extrusion
- 683 Sheet forming
- 684 Laminating
- 685 Casting
- 686 Stamping, machining, fabricating, forming
- 687 Calendaring, coating
- 688 Encapsulation
- 689 Other (filament winding)
- 69 General**
- 690 General (automatic assembly, sewing)

## 7—DESIGN THEORY & TECHNIQUES

- 71 Mechanics**
- 710 General
- 711 Statics (at rest)
- 712 Dynamics (force to create motion)
- 713 Kinematics (motion in abstract)
- 714 Vibration, natural frequency
- 715 Shock
- 716 Noise, sound, music
- 717
- 718
- 719 Other
- 72 Strength of Materials**
- 720 General
- 721 Elastic theory
- 722 Plastic theory
- 723 Fatigue, endurance
- 724 Creep
- 725 Impact stress
- 726 Thermal stress
- 727 Friction, wear
- 728 Fracture
- 729 Other
- 73 Strength of Parts**
- 730 General
- 731 Tension, compression
- 732 Bending
- 733 Shear, torsion
- 734 Surface contact stress
- 735 Plates
- 736 Cylinders, columns
- 737 Rotating discs
- 738
- 739 Other
- 74 Human-Factors Engineering**
- 740 General (life support)
- 741 Styling
- 742 Color
- 743 Safety
- 744 Illumination
- 745 Human limitations
- 746
- 747
- 748
- 749 Other

## 7—DESIGN THEORY & TECHNIQUES (continued)

- 75 Design Analysis & Synthesis**
- 750 General
- 751 Mathematical methods (statistics)
- 752 Graphical techniques
- 753 Analogs, models, simulators
- 754 Computer techniques
- 755 Reliability, quality control
- 756 Dimensioning (tolerances)
- 757
- 758
- 759 Other
- 76 Basic Sciences & Fields**
- 760 General
- 761 Physics
- 762 Chemistry
- 763 Thermal (cryogenics, heat transfer)
- 764 Radiation
- 765 Biosciences
- 766 Optics (photography, holography)
- 767 Ultrasonics
- 768
- 769 Other (economics)
- 77 Experimental Design**
- 770 General
- 771 Prototypes, breadboards
- 772 Testing (stress analysis)
- 773
- 774
- 775
- 776
- 777
- 778
- 779 Other
- 78 Environmental Design**
- 780 General
- 781 Corrosion, rust
- 782 Mold, fungus
- 783 Outer space
- 784 Under sea
- 785 Pollution
- 786
- 787
- 788
- 789 Other
- 79 General**
- 790 General

## 8—ENGINEERING MANAGEMENT & OPERATION

- 81 Engineering Department Operations**
- 810 General
- 811 Structure, organization
- 812 Costs, budgets
- 813 Programing, planning
- 814 Personnel policies
- 815 Recruiting, evaluation, training
- 816 Managerial talent
- 817 Compensation
- 818
- 819 Other
- 82 New Product Development**
- 820 General
- 83 Drafting & Reproduction**
- 830 General
- 831 Management, control systems
- 832 Drafting practices, techniques
- 833 Technical illustration
- 834 Drafting equipment
- 835 Reproduction equipment, systems (microfilm)
- 836 Furniture
- 837
- 838
- 839 Other
- 84 Laboratory & Testing**
- 840 General
- 85 Technical Information**
- 850 General
- 851 Engineering libraries, files, books
- 852 Information classification, retrieval
- 853 Specifications, standards
- 854 Report writing, articles, papers, oral
- 855 Part numbering
- 856 Engineering records
- 857
- 858
- 859 Other
- 86 Patents & Patent Law**
- 860 General
- 87 Personal & Professional**
- 870 General
- 871 Creativity, inventiveness
- 872 Meetings, shows
- 873 Other personal
- 874 Societies
- 875 Professional licensing
- 876 Unions
- 877
- 878
- 879 Other professional
- 88 Outside Services**
- 880 General
- 881 Engineering design services
- 882 Industrial design services
- 883
- 884
- 885
- 886
- 887
- 888
- 889 Other
- 89 General**
- 890 General

## 9—MISCELLANEOUS

- 91 Complete Machines**
- 910 General
- 911 Ordnance (tanks, missiles, rockets, ammunition, SIC 19)
- 912 Machinery (agricultural, construction, machine tools, office machinery, materials handling, SIC 35)
- 913 Electrical machinery (communications, radio radar, TV, appliances, X-ray, SIC 36)
- 914 Transportation (automotive, aircraft, ships, railroad, space craft, undersea craft, SIC 37)
- 915 Instruments (medical, dental, photographic, watches, SIC 38)
- 916 Fabricated metal products (hand tools, etc., SIC 34)
- 917
- 918
- 919 Other
- 99 Unclassified**
- 990 General (includes pages such as Editorials, "Back Talk," Covers, Contents Pages, etc.)



